

lection as *A. pygmæa*, var., no. 87\*. But it is not the original *Annona pygmæa* of Bartram, as his description and good figure show. Shuttleworth and his collector Rugel discriminated the species, but, following Dunal, took it for *A. pygmæa*, and so gave new names to the old species of Bartram. It is not rare in the sandy pine woods of Florida. In setting the species right I am obliged to give it a new name.

*A. pygmæa* DUNAL, Monogr. 84, as to syn., etc. Stems a foot or two high, commonly declined or arcuate: leaves from cuneate-linear to oblong, 1 to 4 inches long, half inch to full inch wide, reticulated: flower greenish turning purple, strongly nodding: outer petals moderately accrescent, at most half inch long, ovate and becoming ovate-lanceolate, not broader nor more than half longer than the ovate inner ones.—*A. pygmæa* largely of authors, and of Curtiss distrib. no. 87. *Annona pygmæa* Bartram, Trav. ed. Amer. 18, t. 1, the figure and description both unequivocal. Bartram says that "the flowers both in size and colour resemble those of the Antrilobe." *Antrilobe* is a puzzle, but I guess it to be a printer's mistake of *An. triloba*. The foliage varies greatly. The commoner narrow-leaved form figured by Bartram was named by Shuttleworth *A. secundiflora*. A form with small and comparatively broad leaves is his *A. reticulata*.

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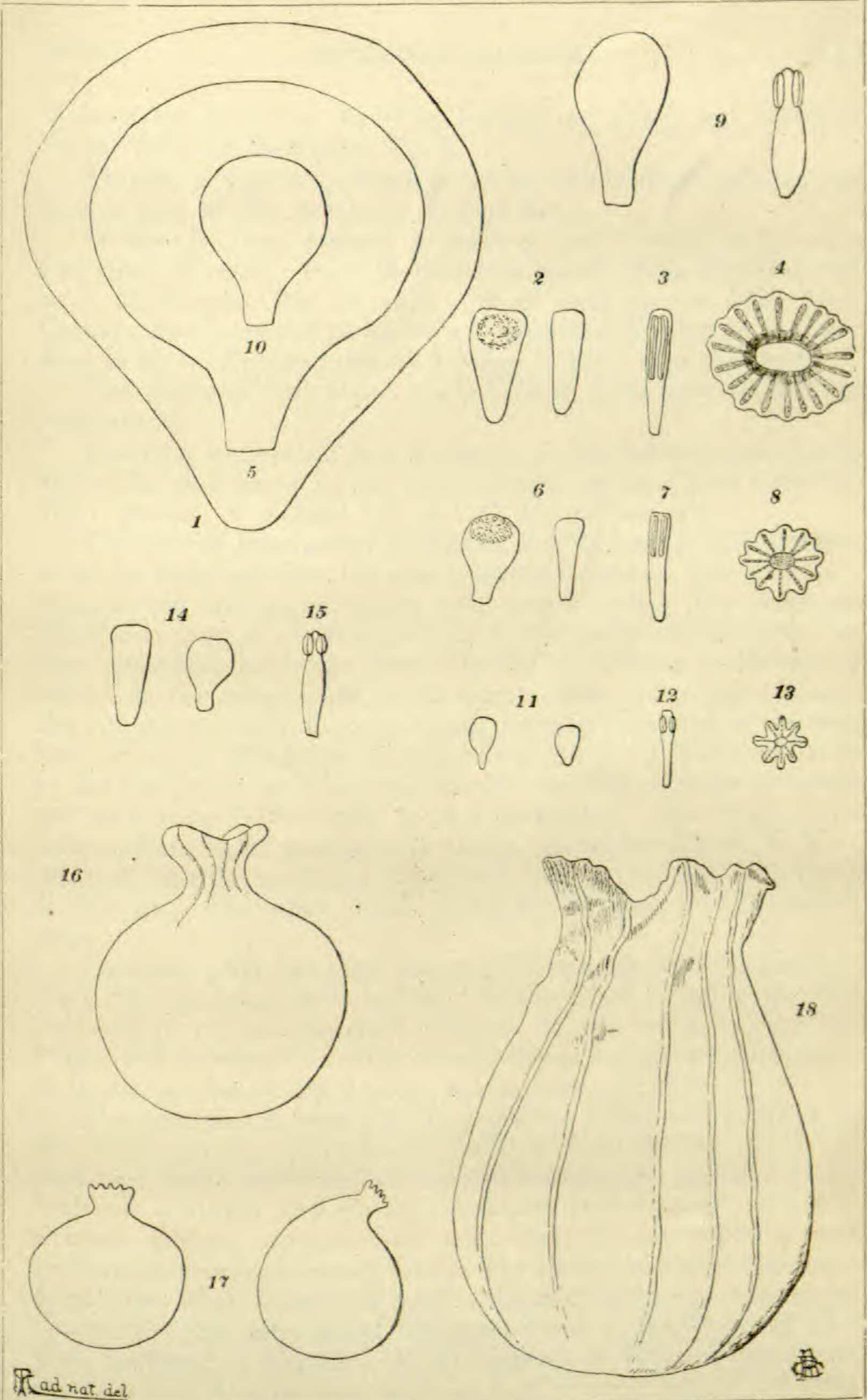
### Revision of the North American species of Nuphar.

THOMAS MORONG.

(WITH PLATE VI.)

Along the shores of Lake Champlain there grows a species of Nuphar, which has long been a puzzle to botanists. It has been variously regarded as *N. luteum* Sm., *N. luteum*, var., *N. Kalmianum* Pursh, and *N. intermedium* Ledeb. Some have pronounced it a hybrid. This Nuphar first attracted my attention two years ago in the Adirondack regions of New York, where it was very abundant in Little Tupper lake and the adjoining waters, Rock Pond and Charley Pond. Since then botanical friends have sent it to me from Ottawa, Canada, from Lake Memphremagog and other places in the Northern States.

Last summer I spent a portion of my vacation in collecting and studying this plant at Ferrisburgh, Vt. It occurs plentifully at that point in the mouths of Lewis and Little Otter creeks, and thence along the Vermont shore to Missisquoi Bay. There



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is also a specimen in the Gray herbarium, which was collected not far from Philadelphia, Penn.

This form appears, therefore, to be widely distributed in the eastern part of the northern United States.

It has also been noticed in some of these localities for quite a number of years. Prof. H. G. Jesup speaks of having observed it at Missisquoi Bay in 1872, and so long ago as 1856 Prof. Caspary had occasion to notice an American *Nuphar* in the gardens at Kew, England, which I judge to have been this form.

The study of this plant has led me to some very interesting conclusions.

The first noticeable fact is, that it is immediately associated, and so far as I know or can learn, *invariably* associated with two other species, *N. advena* Ait. and *N. Kalmianum* Ait.

The second fact is, that it appears almost exactly intermediate in all its parts between the two associated forms. The plate accompanying this paper shows this very clearly. The stigmatic shield or disk of *N. Kalmianum* is distinctly star-shaped, the rays separated half way down, that of *N. advena* is crenate or waved at the margin, while the intermediate form has a shield, the margin of which is more deeply crenate than that of the one, and yet not so deeply cut as that of the other. I find a variation in the specimens as though the shields ran now towards one form and now towards the other in this particular. The fruit of the intermediate form, as a general thing, resembles that of *N. Kalmianum*, but the neck and shoulders exhibit a tendency towards *N. advena*. The other organs speak for themselves in the drawings.

Curiously, too, the disk colors of *N. advena* and *N. Kalmianum* when growing seem to blend in the other, being in the first pale red, in the second dark red, and in the third a beautiful bright red or crimson. This is not seen in herbarium specimens, as in the process of drying they all become uniformly dark.

The next fact is, that this intermediate form, as I found it in the Adirondacks, produces *no fruit*, or scarcely any. After a long and careful search in all the localities in that region, I could find only a single imperfectly developed pericarp, and that had but two or three ripened seed in it, while the associated species bore an abundance of good fruit. The pollen of the intermediate form, also, when examined under the microscope, proved to be unsound. The same defect has been found in specimens of this plant gathered in Canada. Prof. Caspary, of Königsberg, Prussia, to whom flowers were sent by J. Fletcher, Esq., of Ottawa, reported to him that out of 155 grains of pollen examined he

found 95 per cent. bad. This accords nearly with my own determination. We have, therefore, good physiological as well as morphological evidence that this Nuphar is in *these* localities a hybrid between *N. advena* and *N. Kalmianum*.

But how is it with the same plant in Lake Champlain? It still remains associated with the other two species, but in some spots it has wandered to the distance of a mile or more from the others. At Ferrisbergh it is even more abundant than the parental forms. *It also bears an abundance of well developed fruit.* I collected dozens, and could have collected scores of full, ripe berries. The grains of pollen in the freshly opened flowers were scattered freely over the stigmas, and proved, when examined microscopically, *as sound as those of either N. advena or N. Kalmianum.*

I am therefore led to believe that in this locality, on Lake Champlain at least, the hybrid *has been developed into a good species*, perfectly capable of propagating itself by seed; while in other places it still remains a hybrid and infertile. It seems to me that we have the transition complete, first the association of two species, next a mule progeny, and finally a new and perfect species.

I have accordingly ventured to regard it as an undescribed species, and to call it *N. rubrodiscum* from its bright red stigmatic disk.

To account for the blending of the two parental species in so many instances, we are to remember the unusual facility of intercourse between them, which is possibly aided by some special innate tendency to assimilate. The flowers of both are very conspicuous on the surface of the water, for one thing, and when in fresh blossom the corolla is frequently full of small winged insects. I scarcely opened a flower but I found a host of these visitors either upon the stamens or the nectaries. I also noticed a variety of aquatic insects which seemed to make their home upon the leaves and stalks, and to dispute possession of the flowers with their winged rivals. Now here we have a means of spreading the pollen from one flower to another, which is no doubt very effective. The plants also flower all summer long, beginning in May and continuing till September. Besides this they grow generally in quiet water and sheltered nooks where they are protected from disturbing winds and waves. We should therefore expect just such results as we have if there were any hybridizing tendency at all in the species.

I have been led on by interest in these three related forms to look up the other North American species of Nuphar, and the following is offered as a revision of the genus:

**Nuphar SMITH.** Flowers yellow, cup-shaped, single on a stalk which rises to the surface of the water, with the odor of the orange: sepals 5-12, the outer partly greenish on the outside and often ruddy within: petals one or more rows, small, stamen-like, nectary-bearing beneath, inserted with the stamens upon the receptacle around the ovary, sometimes gradually changing into stamens: stamens numerous, in 3-9 rows, at length recurved; anther cells linear, adnate, introrse: the ovary rising at the summit into an urceolate circular or stellate disk, upon which lie 8-21 stigmas in radiating lines or ridges: fruit an ovoid or globular berry, its apex often oblique to the body, having as many cells as there are stigmas, many seeded, the oval seeds without aril. The leaves at base deeply lobed, with a sinus nearly  $\frac{1}{3}$  the length of the blade (except in no. 5), the floating coriaceous, the submerged thin, crisped and broadly cordate, rising from a thick scaly looking rhizome which creeps widely under the mud.

An inhabitant of pools and muddy streams, flowering all summer; of 7 or 8 species in the North Temperate Zone.

1. **N. advena** AIT. Flowers  $1\frac{1}{2}$ -2 inches in diameter when expanded: sepals oblong or cuneate, unequal, the largest  $1\frac{3}{4}$  inches long: petals fleshy, oblong or dilated towards the truncate apex, 4-5 lines long by 2-3 wide: stamens 5-7 rows; anther equaling the filament: stigmas 12-20, on a level with the surface of the disk or slightly raised above it, occasionally not reaching more than half way to the margin; stigmatic disk waved on the margin, pale red when fresh: fruit without a neck under the disk, the largest about 2 inches long by  $1\frac{1}{4}$  inches in diameter: leaves smooth, sometimes pubescent beneath, roundish or ovate, 5-12 inches long by 5-9 inches broad, the sinus usually open; the petioles and peduncles smooth or slightly pubescent; rhizome covered with the scaly scars of former leaves.

Var. (?) **minor.** Specimens without leaves are in Herb. Gray which have flowers about one inch in diameter when expanded, the disk margins more deeply crenate, ten stigmas, and small fruit an inch long by one-half an inch broad.

They are labelled "Smith's Pond, Herkimer Co., Litchfield, New York." Further material is very desirable.

The species is common in the Atlantic States and occurs as far west as the Uinta Mts., Utah, and northward.

2. **N. rubrodiscum.** Sepals similar to the foregoing, the largest  $1\frac{1}{2}$  inches long by  $1\frac{1}{4}$  wide: petals more dilated upwards or even spatulate or obovate, 3-4 lines long by 2 lines broad: the anther about equal to the filament: stigmas 9-12 ridges; disk more deeply crenate than in the preceding, a beautiful bright red or crimson

when fresh, the stigmas lighter in color: fruit with a narrow neck under the disk, about an inch long by an inch diameter: floating leaves vary from 3 to 8 inches in length and 2 to 6 in breadth, the sinus open or closed, occasionally pubescent beneath; submerged leaves orbicular.

*N. luteum* Gray Man. non Sm. The true *N. luteum* Sm. has larger flowers, petals larger and generally more obovate, and stamens larger with broader filaments, as shown in the plate.

Lake Champlain, Vt. Intermediate between *N. advena* and the following, and produced from a hybrid between them. Still a hybrid in many localities.

3. ***N. Kalmianum* AIT.** Smaller than *N. rubrodiscum*, flower an inch broad or somewhat less when expanded: sepals 6–7½ lines long: petals thin and delicate, spatulate or obovate, about 2 lines long by 1 broad: stamens 3 and 4 rows, narrowly linear; the anthers occupying only ¼ of the length: stigmas 7–10 ridges of a golden color upon a dark red stellate shield, which is 2–3 lines in diameter: floating leaves from 2–4 inches long and from 1–3 broad, commonly more or less pubescent beneath, the sinus open or closed; submerged leaves circular, very thin.—Ait. f. Hort. Kew. 3, 295.

*N. pumilum* Caspary, Ann. Mus. Lugd. Bat. 2. 256. Macoun's Cat. Can. Pl. non Smith. *N. luteum* Sm., var. *pumilum* Gr. Man. 57. *N. lutea*, var. *Kalmiana* T. & Gr. Fl. 1. 58.

A beautiful little plant which occurs from Newfoundland to Penn. and as far northwest as the Saskatchewan. It bears a strong resemblance to the European *N. pumilum*, but that differs from our plant morphologically in having the filament much thinner and broader, and the anther broader and shorter. The difference is shown in the plate. The European plant also is commonly much more pubescent. When crossed the two plants produce a hybrid, showing a physiological difference.

4. ***N. polysepalum* ENGELM.** Flowers the largest of the genus, 2–5 inches across when open: sepals 7–12, the largest 2 inches long and nearly as broad: petals 12–18, thick, often reddish, 5 lines long by 3–4 wide, dilated upwards, truncate: stamens 7–9 rows, 5–6 lines long by 1 wide; anthers truncate, equaling the filament: stigmatic disk deeply urceolate, with entire or crenate margins, often pubescent on the top, the stigmas hardly reaching the margins: fruit smooth, ovoid, 1–2 inches in diameter, contracted into a short neck under the disk: seeds rather small as compared with those of *N. advena*: leaves smooth, broadly ovate, 7–12 inches long by 5–9 broad, the sinus open or closed: peduncles and petioles smooth or pubescent, generally quite pubescent when young.—Trans. Acad. St. Louis, 2. 282.

This species is found from Colorado to California and thence northward